

What is claimed is:

- 1 1. A method of preventing peeling between two silicon
2 layers, comprising the steps of:
3 providing a first layer having a first silicon material;
4 performing a hydrogen treatment on the first layer; and
5 forming a second layer having a second silicon material
6 on the first layer.
- 1 2. The method according to claim 1, wherein the first
2 silicon material is amorphous silicon or crystalline silicon.
- 1 3. The method according to claim 1, wherein the second
2 silicon material is amorphous silicon or crystalline silicon.
- 1 4. The method according to claim 1, wherein the hydrogen
2 treatment is a hydrogen plasma treatment.
- 1 5. The method according to claim 4, wherein operational
2 conditions of the hydrogen plasma treatment comprise an RF power
3 of 50~300Watts, a hydrogen gas flow of 200~2000sccm, an operating
4 temperature of 300~400°C, an operating time of 30~90sec and an
5 operating pressure of 0.1~10torr.
- 1 6. The method according to claim 5, wherein the
2 operational conditions of the hydrogen plasma treatment comprise
3 an RF power of 200Watts, a hydrogen gas flow of 600sccm, an
4 operating temperature of 320°C, an operating time of 60sec and
5 an operating pressure of 0.8torr.
- 1 7. The method according to claim 1, wherein the hydrogen
2 plasma treatment is an HF vapor treatment.

1 8. The method according to claim 7, wherein the HF vapor
2 uses HF (49wt%) with a ratio of H₂O: HF= 30:1~70:1.

1 9. The method according to claim 4, wherein the hydrogen
2 plasma treatment and the formation of the second layer are
3 performed in the same processing chamber.

1 10. A method of preventing peeling between two silicon
2 layers in the microelectromechanical structure (MEMS) process,
3 comprising the steps of:

4 providing a first layer having a first silicon material;
5 performing a hydrogen treatment on the first layer to form
6 an H-treated silicon surface with Si-H bonds thereon;
7 and

8 forming a second layer having a second silicon material
9 on the H-treated silicon surface.

1 11. The method according to claim 10, wherein the first
2 silicon material is amorphous silicon or crystalline silicon.

1 12. The method according to claim 10, wherein the second
2 silicon material is amorphous silicon or crystalline silicon.

1 13. The method according to claim 12, wherein the second
2 layer is formed by CVD using SiH₄ as a reaction gas.

1 14. The method according to claim 10, wherein the hydrogen
2 treatment is a hydrogen plasma treatment.

1 15. The method according to claim 14, wherein operational
2 conditions of the hydrogen plasma treatment comprise an RF power
3 of 50~300Watts, a hydrogen gas flow of 200~2000sccm, an operating

4 temperature of 300~400°C, an operating time of 30~90sec and an
5 operating pressure of 0.1~10torr.

1 16. The method according to claim 15, wherein the
2 operational conditions of the hydrogen plasma treatment comprise
3 an RF power of 200Watts, a hydrogen gas flow of 600sccm, an
4 operating temperature of 320°C, an operating time of 60sec and
5 an operating pressure of 0.8torr.

1 17. The method according to claim 10, wherein the hydrogen
2 plasma treatment is an HF vapor treatment.

1 18. The method according to claim 17, wherein the HF vapor
2 uses HF (49wt%) with a ratio of H₂O: HF= 30:1~70:1.

1 19. The method according to claim 14, wherein the hydrogen
2 plasma treatment and the formation of the second layer are
3 preformed in the same processing chamber.

1 20. A method of forming a micromechanical structure,
2 comprising the steps of:
3 providing at least one micromechanical structural layer
4 above a substrate, the micromechanical structural
5 layer being sustained between a lower sacrificial
6 silicon layer having an H-treated surface and an upper
7 sacrificial silicon layer; and
8 removing the upper and lower sacrificial silicon layers;
9 wherein the H-treated silicon surface increases interface
10 adhesion between the lower and upper sacrificial
11 silicon layers.

1 21. The method according to claim 20, wherein the lower
2 sacrificial silicon layer is an amorphous silicon or crystalline
3 silicon layer.

1 22. The method according to claim 20, wherein the upper
2 sacrificial silicon layer is an amorphous silicon layer or a
3 crystalline silicon layer.

1 23. The method according to claim 20, wherein the upper
2 sacrificial silicon layer is formed by CVD using SiH_4 as a reaction
3 gas.

1 24. The method according to claim 20, wherein the H-treated
2 surface of the lower sacrificial silicon layer is performed by
3 a hydrogen plasma treatment.

1 25. The method according to claim 24, wherein operational
2 conditions of the hydrogen plasma treatment comprise an RF power
3 of 50~300Watts, a hydrogen gas flow of 200~2000sccm, an operating
4 temperature of 300~400°C, an operating time of 30~90sec and an
5 operating pressure of 0.1~10torr.

1 26. The method according to claim 25, wherein the
2 operational conditions of the hydrogen plasma treatment comprise
3 an RF power of 200Watts, a hydrogen gas flow of 600sccm, an
4 operating temperature of 320°C, an operating time of 60sec and
5 an operating pressure of 0.8torr.

1 27. The method according to claim 20, wherein the H-treated
2 surface of the lower sacrificial layer is performed by an HF
3 vapor treatment.

1 28. The method according to claim 27, wherein the HF vapor
2 uses HF (49wt%) with a ratio of $H_2O: HF = 30:1 \sim 70:1$.

1 29. The method according to claim 20, wherein the H-treated
2 surface has Si-H bonds.

1 30. A method of forming a micromirror structure,
2 comprising the steps of:

3 forming a first sacrificial silicon layer on a substrate;

4 forming a mirror plate on part of the first sacrificial
5 silicon layer;

6 performing an inert gas sputtering on the mirror plate and
7 the first sacrificial silicon layer;

8 performing a hydrogen treatment on the first sacrificial
9 silicon layer to form an H-treated silicon surface
10 thereon;

11 forming a second sacrificial silicon layer over the mirror
12 plate and the first sacrificial silicon layer;

13 forming at least one hole penetrating the second sacrificial
14 silicon layer, the mirror plate and the first
15 sacrificial silicon layer;

16 filling a conductive material in the hole to define a mirror
17 support structure attached to the mirror plate and
18 the substrate; and

19 removing the first and second sacrificial layers to release
20 the mirror plate.

1 31. The method according to claim 30, wherein the substrate
2 is a glass or quartz substrate.

1 32. The method according to claim 30, wherein the first
2 sacrificial silicon layer is an amorphous silicon layer or a
3 crystalline silicon layer.

1 33. The method according to claim 30, wherein the second
2 sacrificial silicon layer is an amorphous silicon layer or a
3 crystalline silicon layer.

1 34. The method according to claim 30, wherein the second
2 sacrificial silicon layer is formed by CVD using SiH_4 as a reaction
3 gas.

1 35. The method according to claim 30, wherein the inert
2 gas sputtering is argon sputtering.

1 36. The method according to claim 30, wherein the hydrogen
2 treatment is a hydrogen plasma treatment.

1 37. The method according to claim 36, wherein operational
2 conditions of the hydrogen plasma treatment comprise an RF power
3 of 50~300Watts, a hydrogen gas flow of 200~2000sccm, an operating
4 temperature of 300~400°C, an operating time of 30~90sec and an
5 operating pressure of 0.1~10torr.

1 38. The method according to claim 37, wherein the
2 operational conditions of the hydrogen plasma treatment comprise
3 an RF power of 200Watts, a hydrogen gas flow of 600sccm, an
4 operating temperature of 320°C, an operating time of 60sec and
5 an operating pressure of 0.8torr.

1 39. The method according to claim 36, wherein the hydrogen
2 plasma treatment and the formation of the second layer are
3 preformed in the same processing chamber.

1 40. The method according to claim 30, wherein the hydrogen
2 treatment is an HF vapor treatment.

1 41. The method according to claim 40, wherein the HF vapor
2 uses HF (49wt%) with a ratio of H_2O : HF= 30:1~70:1.

1 42. The method according to claim 30, wherein the mirror
2 plate is an OMO (oxide-metal-oxide) layer.

1 43. The method according to claim 30, wherein the
2 conductive material comprises at least one of W, Mo, Ti and Ta.

1 44. A method for forming a micromirror structure,
2 comprising the steps of:

3 forming a first sacrificial silicon layer on a substrate;
4 forming a mirror plate on part of the first sacrificial
5 layer;

6 performing an inert gas sputtering on the mirror plate and
7 the first sacrificial silicon layer;

8 performing a hydrogen treatment on the first sacrificial
9 silicon layer to form an H-treated silicon surface
10 thereon;

11 forming a second sacrificial silicon layer over the first
12 sacrificial layer and the mirror plate;

13 partially etching the first and second sacrificial silicon
14 layers to create an opening exposing a portion of
15 the mirror plate and at least one hole exposing a
16 portion of the substrate;

17 filling a conductive material in the opening and the hole
18 to define a mirror support structure attached to the
19 mirror plate and the substrate; and
20 removing the first and second sacrificial silicon layers
21 to release the mirror plate.

1 45. The method according to claim 44, wherein the substrate
2 is a glass or quartz substrate.

1 46. The method according to claim 44, wherein the first
2 sacrificial silicon layer is an amorphous silicon layer or a
3 crystalline silicon layer.

1 47. The method according to claim 44, wherein the second
2 sacrificial silicon layer is an amorphous silicon layer or a
3 crystalline silicon layer.

1 48. The method according to claim 44, wherein the second
2 sacrificial silicon layer is formed by CVD using SiH_4 as a reaction
3 gas.

1 49. The method according to claim 44, wherein the inert
2 gas sputtering is argon sputtering.

1 50. The method according to claim 44, wherein the hydrogen
2 treatment is a hydrogen plasma treatment.

1 51. The method according to claim 50, wherein operational
2 conditions of the hydrogen plasma treatment comprise an RF power
3 of 50~300 Watts, a hydrogen gas flow of 200~2000 sccm, an operating
4 temperature of 300~400°C, an operating time of 30~90 sec and an
5 operating pressure of 0.1~10 torr.

1 52. The method according to claim 51, wherein the
2 operational conditions of the hydrogen plasma treatment comprise
3 an RF power of 200Watts, a hydrogen gas flow of 600sccm, an
4 operating temperature of 320°C, an operating time of 60sec and
5 an operating pressure of 0.8torr.

1 53. The method according to claim 50, wherein the hydrogen
2 plasma treatment and the formation of the second layer are
3 preformed in the same processing chamber.

1 54. The method according to claim 44, wherein the hydrogen
2 treatment is an HF vapor treatment.

1 55. The method according to claim 54, wherein the HF vapor
2 uses HF (49wt%) with a ratio of H₂O: HF= 30:1~70:1.

1 56. The method according to claim 44, wherein the mirror
2 plate is an OMO (oxide-metal-oxide) layer.

1 57. The method according to claim 44, wherein the
2 conductive material comprises at least one of W, Mo, Ti and Ta.